

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 18.]

JUNE.

[1888.

XLVII.—MANUFACTURE OF QUININE IN INDIA.

The following important papers have been communicated to this establishment by the Government of Bengal, and are published for the information of the colonies in which *Cinchona* is grown.

The historical summary of the introduction of quinine-yielding plants from South America into India, may be supplemented by a reference to the annual reports of the Royal Gardens, from 1862 to 1880, which give in detail an account of the part played by this establishment in successfully carrying out this important enterprise. From Kew the different species of *Cinchona* were also distributed to Ceylon, and other British tropical colonies.

Hitherto red bark (*Cinchona succirubra*) has been the dominant species cultivated in the Sikkim plantations. This was entirely worked up in the manufacture of febrifuge, which contained but a small proportion of quinine, but a large amount of Cinchonine and Cinchonidine. The new process now described is intended for the manufacture of quinine from yellow bark (*Cinchona Calisaya*). If successful, it will lead to the substitution of Indian-manufactured quinine for the febrifuge in the hospitals and dispensaries of India, and as a necessary consequence to the substitution of yellow bark for red bark in the Sikkim plantations.

L O N D O N :

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1888.

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FINANCIAL DEPARTMENT, CALCUTTA, March 26, 1888.

Apprehensions of the extermination, in their native forests, of the quinine-yielding *Cinchona* trees having reached an acute stage about 30 years ago, the Government of India decided to take effectual steps to introduce their cultivation into India. The collection of seed and seedlings in the wide tract of difficult country over which the best medicinal sorts are naturally scattered, was no easy task. But it was successfully accomplished by Messrs. Markham, Pritchett, Spruce and Cross. Contemporaneously with these efforts on the part of the English Government, the Dutch authorities were at work on behalf of their Malayan Colonies, and by the year 1862, *Cinchona* cultivation had been successfully initiated in India and Malaya. The localities selected for the experiment of *Cinchona* growing in India were the Nilgiris and British Sikkim. And the excellence of this selection has been proved by the fact that the original nurseries in both localities have developed into large plantations which still remain in the hands of Government. From these two centres, seed and seedlings have been freely distributed to planters, and large tracts of land, especially in Southern India and Ceylon, have been covered with *Cinchona* trees by private enterprise.

2. The *Cinchona* trees thus introduced into India are practically of two sorts: (1) *quinine* yielders, and (2) *mixed Alkaloid* yielders. Of the quinine yielders there are two kinds, viz., *yellow* or *Calisaya* (including *Ledgeriana*), and *Crown* or *officinalis*, barks. Of the mixed alkaloid yielders, there are also two kinds, viz., *red* or *succirubra*, which has been in cultivation from the beginning, and a kind which has come into prominence during the past few years, and which, in annual reports, has been referred to as *Hybrid* bark. Red bark contains a comparatively small proportion of quinine, with large proportions of Cinchonidine and Cinchonine. It had been chiefly used by druggists in the preparation of decoctions and tinctures, and had not been used by quinine makers as a source of quinine. This red-bark tree was, however, the kind which, in the early days of the cultivation, it was found most easy to propagate; and in all plantations, both public and private, it greatly preponderated over the other sorts.

3. The cultivation of *Cinchona* trees having been pushed beyond the region of experiment, the next problem that presented itself was the utilization of their bark. For the private grower, the most lucrative course, up to the present time, has been to sell the crude bark in London. The object of Government was not, however, to secure a financial success, but to provide the people of the country, at the lowest possible rate, with an efficient remedy for the most prevalent of all the diseases of the country. The first step for Government to take was, therefore, to discover whether it was really a fact that quinine is the only alkaloid worth extracting separately from *Cinchona* bark, and whether Cinchonidine and Cinchonine might not each be an efficient febrifuge. It was true that quinine alone had got into use as a febrifuge, and that it alone of the *Cinchona* alkaloids had found a place in the British Pharmacopœia. On the other hand, tinctures, decoctions, and various pharmaceutical preparations of red bark, into the constitution of which all three alkaloids must undoubtedly enter, had for many years borne the reputation of excellent remedies for fever. The presumption, therefore, appeared to be that the position claimed for quinine as the only real febrifuge yielded by *Cinchona* bark, would prove, on careful examination, to be untenable; and that the other two alkaloids would also be found to have value as febrifuges. For the purpose of

investigating this point, commissions of medical officers of all three Presidencies were formed during the years 1866 to 1868. These commissions were furnished with supplies of the three alkaloids, pure and unmixed, and after very extensive trials, their unanimous verdict was that Cinchonidine and Cinchonine are both excellent febrifuges, the former not much less efficient than quinine itself.

4. Having thus established the value of Cinchonidine and Cinchonine, the next point to be settled was how best to utilize the large stocks of these alkaloids contained in the bark of the trees growing in the Government plantations. To do this, Messrs. Broughton and Wood, two professional chemists, were engaged in England, and were located as Government quinologists on the Nilgiri and Sikkim plantations respectively. Mr. Broughton (the Nilgiri quinologist), as the result of his labours, invented a preparation of red bark, which he called *Amorphous quinine*, and which contained all the alkaloids of red bark in the form of a non-crystalline powder. Of this Amorphous quinine, no large amount was ever manufactured; and its preparation ceased when Mr. Broughton resigned the service of Government. Mr. Wood, who did not arrive at the Sikkim plantation until 1873, concluded, after much observation and experiment, that the best way of utilizing the red bark was to make from it the preparation now so well known as Cinchona febrifuge. This, like Mr. Broughton's, is in the form of a powder, and contains the three chief alkaloids of red bark mixed in the proportions in which they naturally occur in the bark. Cinchona febrifuge was then a perfectly new product, unknown to pharmacy, and it was not clear how it might be accepted by the medical profession.

Mr. Wood, therefore, adopted for its manufacture, on a small tentative scale, a simple and inexpensive acid and alkali process, requiring only the rudest apparatus. He intended, should the product be favourably accepted by the medical profession, to replace this simple process by one more efficient, but more complicated, and involving the extensive use of spirit. During the first year of its manufacture (1874-75), only 48 pounds of this new drug were issued. At first, and chiefly owing to, a misapprehension as to the proper dose in which it should be given, some prejudice existed against this drug. In 1875-76, however, 1,940 pounds of it were consumed, and its consumption so materially increased during succeeding years, that, up to the present date, no less than 87,704 pounds have been issued from the factory. A preparation similar to, and avowedly an imitation of, Cinchona febrifuge, is now made and sold in London under the name of *Quinetum*, but until Cinchona febrifuge had first been manufactured in India, no similar preparation existed. It is, therefore, a remedy for which the world at large is indebted to India. Cinchona febrifuge has been used in India as a substitute for quinine. It has been so used by Government in its own medical institutions, and it has been freely offered to the Indian public. Its sale has, however, been restricted to the limits of India. From the beginning, and until now, its price has uniformly been 16 rupees 8 annas per pound, and in this respect it has presented a contrast to quinine, the price of which has fluctuated considerably, rising at one time as high as 16s. 6d. per ounce. According, however, to statistics prepared by an English pharmacologist, the average price of quinine in London from 1875 to 1887 (the period during which Cinchona febrifuge has been in use) has been 8s. 4½d. per ounce. The sterling value (calculated at this average rate) of 87,704 pounds of quinine would be 587,616l., while this quantity of febrifuge has actually been delivered to the Indian consumer for the sum of Rs. 14,47,116.

The actual saving to India has, therefore, been very great, and the capital account of the plantations (about 11 lakhs of rupees) has been covered several times.

5. The preponderance of red bark trees in the Sikkim plantation, while he was attached to it, naturally induced Mr. Wood to give his attention first to the utilization of their bark. But he by no means neglected the quinine barks. Of these barks only one,—*Calisaya* and its variety *Ledgeriana*,—really thrives in Sikkim, the Crown bark, or *Cinchona officinalis*, tree having proved a comparative failure. Mr. Wood made many experiments in the manufacture of pure sulphate of quinine; but, up to the time of his retirement, for private reasons, from the service of Government in 1879, he had not succeeded in discovering an efficient process. Mr. Wood was of opinion that good quinine barks could be grown in Sikkim, and that it might be possible to extract the quinine from them on the plantation. Dr. King, the superintendent of the plantation, was very strongly of this opinion, and in 1875 he recommended that all further planting of red bark trees should cease. This recommendation was not acted upon for some time. Full effect, has, however, been given to it of recent years, and *succirubra* has been supplanted by *Calisaya* to the extent of about a million trees. The retirement of Mr. Wood did not put an end to the experiments on the manufacture of quinine. Mr. Gammie, the resident manager, took the matter up with energy, and, encouraged and assisted by Dr. King, he carried on a long series of experiments on an acid and alkali process of manufacture by which he succeeded in producing excellent quinine. He never, however, succeeded in recovering much more than half of the amount contained in the bark upon which he operated. The acid and alkali process had therefore to be abandoned as wasteful and inefficient. A process depending on the maceration of the bark in spirit was next tried; but, after much experiment, it was in turn abandoned. During a visit which he paid to Holland in 1884, Dr. King acquired some hints as to a process of extraction by means of oil. And now, benefiting by the advice of some chemical friends, Mr. Gammie has been able to perfect this process, with the result that the whole of the quinine in yellow bark can be extracted in a form undistinguishable, either chemically or physically, from the best brands of European manufacture. This can be done so cheaply that, as long as the supply of bark is kept up, quinine need never cost Government much above 25 rupees per pound. It is true that at the present moment, quinine is obtainable in the open market at rates not very different from this, but that is due to entirely exceptional causes. For some time back the Ceylon planters have been uprooting their *Cinchona* trees, both to save them from disease, and to make way for tea planting, which appears now to be becoming the principal industry of that colony, and *Cinchona* bark has actually been sold in London below the cost of its production in Ceylon. Indeed, so far has the fall in price gone, that South American bark has been practically driven out of the market. This is a state of matters which cannot continue very long, and which is not likely to recur. In the ordinary course, therefore, quinine might be expected soon to rise to what may be considered its normal price. The object of making public the process now discovered is to check this rise in the price of a drug of such general utility.

6. The cordial thanks of Government are due to Dr. King and his coadjutors—and especially to Mr. Gammie—for the patience, energy, and resource displayed by them in their long search for the best method of utilizing these valuable medicinal barks. The Government has no

desire to make a profit by the discovery, and the details are now produced in order that private growers of Cinchona may be enabled to take full advantage of the process, and that a permanent reduction in the price of quinine may ensue.

COLMAN MACAULAY,
Secretary to the Government of Bengal.

Method of Extraction of the Alkaloids from Cinchona Bark by Cold Oil as used at the Government Cinchona Factory in Sikkim.

In order that the oil may speedily and effectually act on the Cinchona bark, the latter is reduced to a very fine powder by means of Carter's disintegrator, and to get the powder of a uniform fineness it is passed through a scalper, which is a machine commonly used for sifting flour. The scalper is in the form of a box enclosing a sloping six-sided, revolving chamber, covered with silk of 120 threads to the lineal inch. It is driven at the speed of about thirty revolutions to the minute. Any particles of the powder which may be too coarse to pass through the silk meshes drop out at the lower end of the revolving chamber and are again passed through the disintegrator.

2. A hundred parts of the finely-powdered bark are then set aside to be mixed with eight parts of commercial caustic soda, 500 parts of water, and 600 parts of mixture composed of one part of fusel oil to four parts kerosine oil. If the caustic soda be of inferior quality, a little slaked lime (about five parts) may be used in addition to the eight parts of caustic soda, or caustic soda may be altogether omitted, and 15 parts of slaked lime may be used instead of it. The caustic soda is dissolved in the water and mixed with the bark. Then the oil is added, and the whole is kept thoroughly intermixed in an agitating vessel. Should lime be used, it is mixed in fine powder with the dry bark before adding the water and oil.

3. The agitating vessels in use at Mungpoo are barrels with winged stirrers revolving in them vertically, and with taps on the sides for drawing off the fluids. The first stirring is carried on for four hours, and then the whole is allowed to rest quietly in order that the oil may separate out to the top of the watery fluid. When the oil, which has now taken up the greater part of the alkaloids, has cleared out, it is drawn off by a tap placed just above the junction of the two fluids. The oil is then transferred to another agitator, and is there thoroughly intermixed with acidulated water, for five or ten minutes, the mixture being again allowed to rest for the separation of the oil. It will now be found (if sufficient acid has been used and the stirring has been thorough) that the alkaloids have been removed from the oil to the acidulated liquor. The oil is again transferred to the bark mixture, and is kept intermixed with it for two or three hours; the oil is again drawn off in the same way, washed as before in the same acidulated liquor, and this process is repeated a third or a fourth time or until it is found, by testing a small quantity of the oil, that the bark has been thoroughly exhausted of its alkaloids. Each stirring subsequent to the second need not be continued for more than an hour. The quantity of acid required to take up the alkaloids from the oil will entirely depend on the quality of the bark operated on. If the bark contains 4 per cent. of alkaloids, about 2 lbs. of either sulphuric or muriatic acid mixed in 20 gallons of water should be sufficient, and so on in proportion.

4. The after-treatment of the acidulated water containing the alkaloids depends on the product desired, and on the kind of acid that has been used. Should sulphate of quinine be desired and sulphuric

acid have been used, the liquor is filtered (if necessary), heated and made neutral by adding a very weak solution of either caustic soda or liquor ammonia. It is then allowed to cool, and as it cools the crystals form out. These crystals are afterwards separated from the mother liquor by draining through a cloth filter. After they have been thus obtained, the crystals are dried. They are next dissolved in about 50 times their weight of boiling water. The resulting liquor is filtered hot through a little animal charcoal. On cooling after filtration, the crystals again form out, and they are separated as before from the mother liquor by filtration through a cloth. The crystalline mass obtained by filtration is then placed in small lumps on sheets of white blotting paper stretched on slabs of plaster of Paris. By this means they are practically dried. They are afterwards thoroughly dried by being laid on blotting paper in a room heated to about 10 degrees above the temperature of the open air.

5. If Cinchona febrifuge is wanted, the alkaloids are exhausted from the oil by muriatic acid, the solution being neutralized and filtered in the same way. On an excess of caustic soda solution being added, the alkaloids are precipitated. After standing some hours, the whole bulk of liquor and precipitate is passed through cloth filters; and when the alkaline liquor has drained off, the precipitate is washed with a little plain water, dried, and powdered. The powder is Cinchona febrifuge ready for use.

March 24, 1888.

J. A. GAMMIE.

XLVIII.—JOB'S TEARS.

(*Coix Lachryma*, *L.* var. *stenocarpa*.)


The round shining fruits of a grass widely distributed in tropical countries are familiarly known as Job's Tears. The fruits when young are supposed to have some resemblance to heavy drops of tears, and hence the fanciful name they bear. The plant, a native of the East Indies and Japan, belongs to the tribe *Maydeæ* of the natural order, Gramineæ. It is a tall growing grass, now commonly found in damp places in the tropics of both hemispheres. In many countries it is regarded as a troublesome weed and a source of annoyance, especially in rice fields. As far as we are aware, the fruit possesses no nutritive qualities, and, except in one instance which has come under the notice of Mr. C. B. Clarke, F.R.S., in the Naga Hills, Assam, it is not cultivated as a grain nor used in the wild state. The stem is stout, erect, and smooth in all its parts. In favourable situations it often attains a height of three to five feet. The leaves are broad and flattish, about a foot long, with a distinct midrib. The flowers are monœcious, male and female in different parts of the same panicle. The female flowers are one or more in number at the bottom of each branch of the panicle. They are enclosed in a hard bottle-shaped or round white or grey involucre, from which the long stigmas protrude. The male flowers are in the upper spikelets, numerous and two-flowered. After flowering, the simple branches of the panicle break away above the female spikelets, so that when the fruit is ripe, the male spikelets have entirely disappeared.

The globular Job's Tears as commonly found in the tropics are used for necklaces, and in various ways as articles of ornamentation. The usual colour is white, but they are sometimes found slightly tinged with pink, and sometimes grey, or almost black.



M.S. del. et lith.

Coix Lachryma, L. var. *stenocarpa*.



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The present variety of Job's Tears with long cylindrical involucre was brought into notice at the late Colonial and Indian Exhibition, 1886. In the ethnological collections in the Indian Court the clothing of Karens (a semi-aboriginal tribe inhabiting certain districts of Lower Burma) was prettily ornamented with these cylindrical involucres, and attracted considerable attention. As these were not represented in the Kew museums, application was made to the India Office for a small sample, which, at the request of Lord Cross, was lately forwarded to Kew by the Chief Commissioner of Burma. The involucres in this sample vary from five to nine lines in length. They are usually more or less fusiform, tapering at the ends to about one line in diameter. The mean thickest part is about $1\frac{1}{2}$ line in diameter. For herbarium specimens of the plant yielding these fruits, we are indebted to Dr. George Watt, Scientific Assistant to the Director of Agriculture, Calcutta. There is a form with shorter involucres collected at Mergui by Mr. Griffith. In a note attached to pl. 1,764, in the *Icones Plantarum*, Vol. VIII., Professor Oliver states that the Kew Herbarium possesses, in addition to the packet of involucres from the India Office, "a letter from Mr. R. Bruce, of Balipara, Assam, to Mr. H. C. Read, of the British Museum, saying that the involucres are known to the Assamese and the Meris, and called by them the cowr-monee or crow bead, from the fondness of these birds for the berry."

In an office memorandum, dated Simla, 22nd December 1887, Dr. Watts states, that "the grain (of this variety of Job's Tears) is not likely to prove of any great economic value as a source of food, but it stands an admirable chance of being largely used in Europe in the construction of artificial flowers, laces, bugle trimmings, and other purposes for which glass beads are being used. If capable of being dyed a deep black colour, there might be a very extensive demand, since such beads would be infinitely more durable than glass. During the Exhibition, several gentlemen, especially from France, inquired after seeds suitable for the above purposes. The writer was not able at the time to furnish them with samples of the cylindrical form of Coix now under consideration, but showed them the ordinary spherical form. They seemed to think there was some prospect even of the common spherical form coming into use, but objected to its large size. This led the writer to show them the Karen garments with the cylindrical form of seeds used as decorations. This they were highly pleased with. In hopes of still further developing the matter, the writer drew Mr. Thiselton Dyer's attention to them, with the result that the present inquiry has now been instituted."

We are enabled, by permission of the Bentham Trustees, to add a plate of this variety of Job's Tears, from the current issue of the *Icones Plantarum* [Vol. VIII., pt. 3, pl. 1,764].

XLIX.—RAMIE OR RHEEA.

(*Boehmeria nivea* var. *tenacissima*.)

The plant known under the several names of China Grass, Ramie, or Rhea, belongs to the natural order, *Urticaceæ*, and hence it is not a grass at all, but a species of nettle, somewhat resembling in appearance and habit of growth, the common nettle of Europe.

The China Grass plant, first known and long cultivated by the Chinese under the name of Tchou Ma, is the *Boehmeria nivea* of botanists. The specific name, *nivea*, was given to it on account of the white appearance on the under-side of the leaves. A plant called in Assam, Rhea, and in the Malay Islands, Ramie, was believed by Roxburgh to be distinct from the Tchou Ma of the Chinese, and it was named by this botanist *Boehmeria (Urtica) tenacissima*. In this plant there is an absence of the white-felted appearance on the under-side of the leaves, so characteristic of the China Grass plant, but in all other respects the two plants are identical in their botanical characters.

For purposes of classification, the Tchou Ma, or China Grass plant, *Boehmeria nivea*, may be accepted as the typical species, and the Rhea or Ramie retained as a geographical variety of it, under the name of *Boehmeria nivea* var. *tenacissima*. This latter is sometimes known as the Green-leaved China Grass, a name which may be conveniently retained for it.

The fibre yielded by these plants has been long recognised as pre-eminent amongst vegetable fibres for strength, fineness, and lustre. Hence numerous attempts have been made to cultivate them, and to prepare the fibre in large quantities for commercial purposes. The plants are exceedingly easy of cultivation, and thrive in all soils, but preference should be given to those of a light loamy character. It is essential that the climate be moist and stimulating, in order to produce abundant and frequent crops of stems. The plants may be raised from seed, but the more ready method is by root or stem cuttings. The roots being perennial, the stools become stronger and more vigorous every year, and from these, fresh sets are easily obtained for extending the cultivation.

Numerous attempts have been made during the last 10 years to extract the valuable fibre which exists in this plant. The experimental processes hitherto employed may be briefly classed as either mechanical or chemical. In the first, it has been sought to extract the fibre from the green stems, by means of rapidly revolving beaters attached to a drum driven by steam power. In some cases, water is used to wash the fibre while under the beaters. The chief difficulty experienced in this method, is the small quantity of fibre cleaned per day. This has enhanced the cost to such an extent, as to render the process practically unremunerative. In the chemical processes, the Ramie stems are treated green or dry. The object sought is to treat the stems either under great pressure with steam or with chemicals, so as to dissolve the gum in which the individual fibres are immersed. After being thus treated, the fibres are easily detached from the stems by hand or by machinery, and are sent to market in the form of ribbons. The question of cost is here also very important, and it is felt, under present circumstances, that China Grass can only be satisfactorily grown and prepared where there is an abundance of cheap labour.

It is a fact universally known, that the fibre of the China Grass is one of the finest and strongest known. If a process could be devised that would extract and clean the fibre at a cheap rate, the results would prove of the greatest possible interest to all our tropical colonies. The China Grass plant can be grown as easily as the sugar cane, but in spite of many years of continuous effort, the problem how to prepare the fibre on a large scale, and place it in the market at remunerative rates, is apparently still unsolved.

We gather from the numerous applications made to Kew for information, that interest is still maintained in the China Grass or Ramie,

and under these circumstances it is felt to be desirable to place on record the latest facts that have been gleaned respecting the present position of the industry.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

SIR

Royal Gardens, Kew, April 16, 1888.

I AM desired by Mr. Thiselton Dyer to inform you that considerable interest is being taken in British Colonies in the culture of the Ramie plant, known as Rhea and China Grass (*Boehmeria nivea*).

2. Hitherto the industry has not assumed large proportions anywhere, owing to the want of a thoroughly suitable machine to prepare the fibre.

3. In the Foreign Office Report, for the year 1887, on the agriculture of the Barcelona district [No. 275, Annual Series, 1888], Mr. Consul Wooldridge states, that in the province of Cataluña, "Machines are already in use, capable of decorticating the [Ramie] fibre on a profitable scale."

4. Mr. Thiselton Dyer is of opinion that it is very desirable to obtain from Mr. Wooldridge the names of the makers of the machines which appear to have successfully solved the problem of decorticating Ramie stems. Any particulars he could add as regards the cost of the machines, the power necessary to drive them, and the out-turn of clean fibre per day, would prove of the greatest possible interest to planters in our tropical countries.

I have, &c.,
(Signed) D. MORRIS.

Sir T. Villiers Lister, K.C.M.G.

MR. CONSUL WOOLDRIDGE to the MARQUIS OF SALISBURY.

MY LORD MARQUIS,

Barcelona, April 25, 1888.

I HAVE the honour to acknowledge the receipt of Sir James Fergusson's despatch, of the 19th instant, on the subject of the machines used in Cataluña for decorticating the stalks of the Ramie plant; and I am directed to report to your Lordship the names of the makers of the machines, and to give any further particulars which might prove of interest to planters in British tropical colonies.

Although the Ramie plant has been cultivated for many years in the north of Cataluña, it is only within the last two years that, through the invention of a decorticating machine by a Monsieur Favier, member of the "Société La Ramie Française," it has been brought before the public. M. Favier has a factory, called the "Fabrica Favier," at Torroella de Montgri, in Gerona, in the vicinity of the Ramie plantations, where his decorticating machines are at work.

These machines are used to decorticate the stalks in a dry state, after having been cut and exposed to the powerful rays of the sun for 48 hours, as experiments and practice show that the operation on the green Ramie is impracticable.

It appears that M. Favier has been the first to solve the problem of decorticating Ramie with success; and, according to Professor Obiols his machine leaves nothing to be desired; and of this invention the "Centralblatt," of Berlin, in its number of January 23, 1883, says:—"Although the use of the Ramie, as a textile plant, dates from time

“ immemorial, the separation of the fibre from the stalk has been found
 “ hitherto so surrounded with difficulties that no hope existed of any
 “ considerable extension in its use; however, since M. Favier has dis-
 “ covered a machine for the purpose of separating the fibre, a real revolu-
 “ tion has been produced in the industrial world, and the cultivation of
 “ the Ramie plant has taken extraordinary proportions.”

Another decorticating machine, similar to the Favier one, has, however been invented by a Monsieur Billion, of Marseilles, who obtained a patent for it in Spain, but, being considered by M. Favier as a piracy, the latter prosecuted M. Billion, who eventually came out triumphant; and, although this machine has not been used in Spain, some persons consider it to be superior to the Favier one.

Full descriptions are given of these machines in Professor Obiols' pamphlet (in Spanish), and can be purchased for a few pesetas.

The Billion machine can produce 300 kilogrammes of fibre a day, showing an advantage over the Favier one.

The Favier machine is not for sale to the public, the inventor preferring to establish factories near the plantations and purchase the produce from the agriculturists, and decorticate and manufacture threads, &c., himself, as the “ Société La Ramie Française ” is doing at Torroella. Neither, I believe is the Billion machine to be acquired for money.

There is another machine, known as the “ Agramadera (flax-dresser) Kaulek,” invented by M. Kaulek, of Paris. Its size is a cubic metre, and it requires half a horse-power to put it in motion, and can be worked by the arm, by a windmill, or by steam. It is portable, weighs 350 kilos., and its price is 2,000 fr. (80*l*.) It has been known to produce 175 kilos. of commercial Ramie, in ribbons, in 10 hours,

Another machine has been invented in Barcelona by Don Demetrio Prieto for extracting fibre from textile plants, and many of his machines are in use, with success, in Mexico. The inventor is about to introduce certain modifications in this machine, in order to adapt it to the decortication of the Ramie plant.

The personnel required to work the Favier machine, and the cost per diem (in Cataluña), are as follows:—

	Pesetas	c.
Two men to separate the extremities of the stalks -	0	75
One man to introduce the stalks -	1	50
One man to receive the fibre -	1	50
One man to supply the stalks to the introducer -	0	75
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	5	25

or about 4*s*. per day for each machine; and for, say, a 1,000 kilos. of dry stalks the proportional out-turn would be as follows:—

50 kilos. of extremities, or 5 per cent. of the whole weight.
 190 kilos. of fibre, or 20 per cent. of the whole weight.
 570 kilos. of wood.
 100 kilos. of pellicles, and
 90 kilos. of loss.

Yet the wood, extremities, and pellicles may all be utilized.

Taking the working of 20 of Favier's machines, which would require about 10 horse-power of steam, the expenses and profits result as follows:—

Cost of installation, 120,000 pesetas, or francs, each machine costing 6,000 fr., with the necessary capital of 60,000 fr.

Actual cost of stalks of Ramie (in Spain), 100 pesetas per 1,000 kilos; and each machine decorticating 216 kilos. per day.

Expenses.

			Pesetas	c.
4,320 kilos. of stalks	-	-	-	432 00
Labour	-	-	-	108 00
Incidental expenses	-	-	-	122 00
Total	-	-	-	662 00

Products.

5 per cent. of extremities	-	-	-	10 80
20 per cent. of decorticated stalks, or 864 kilos. of fibre	-	-	-	864 00
57 per cent. of wood	-	-	-	61 50
10 per cent. of pellicles	-	-	-	17 20
9 per cent. of loss.				
Total	-	-	-	953 50
Total products	-	-	-	953 50
Total expenses	-	-	-	662 00

Clear profit - per day 291 50

or 117,150 pesetas per annum of 300 days of labour, which represent approximately 48 per cent. of the capital.

The Favier machine has the advantage of extracting the fibre and making the threads clear of gum, for in the raw Ramie which comes from China and India, there is so much gum that it is most difficult to cleanse. These machines, as I said before, are not yet within the reach of agriculturists, that of M. Favier being used by the inventor, and that of M. Billion having ceased to work in Spain.

I have, &c.,

(Signed) FRANK WOOLDRIDGE.

L.—BOTANICAL STATION AT LAGOS.

In the *Kew Bulletin* for the months of June and July 1887, there were discussed the details of a scheme of botanical stations for the West India Islands. These botanical stations are intended to supplement the operations of the botanic gardens already established in the larger islands, and are simple and inexpensive agencies, chiefly devoted to the work of raising and distributing useful economic plants, and to cultivating experimentally on a small scale such vegetable products as offer the most convenient and suitable means for improving local industries. Botanical stations, as distinct from botanical gardens, are intended to be supervised by working gardeners, native or European, who have been specially trained in the details of nursery work in the tropics.

Profiting by the experience gained in the West Indies, it has been sought to extend the system of botanic stations to the West African Colonies, which hitherto have been without a local botanical agency of any kind.

The prosperity of these colonies has chiefly depended on palm oil, ground nuts, and various forest products, more or less of a precarious

character. These are just now in a depressed state, and hence it is felt that some effort should be made to encourage the growth of coffee, cacao, maize, indigo, rice, cotton, ginger, india-rubber, cocoanuts, tobacco, and any other plants suited to the soil and climate.

Captain Moloney, C.M.G., the present Governor of the Colony of Lagos, has given considerable attention to West African products. He has been in correspondence with Kew for many years, and contributed numerous specimens to the museums, as well as dried plants for purposes of determination. Recently, Captain Moloney has published a work on the forest products and economic plants of West Africa, which is a valuable summary of information relating to the flora of tropical Africa.*

The principal West African Colonies are the Gambia, Sierra Leone, Gold Coast, and Lagos. The extent of these Colonies may be estimated from the fact that coast line of the Gold Coast Colony alone is 350 miles, and that the total area of the British Protectorate is from 24,000 to 30,000 square miles. The staple products of this Colony are palm oil and palm kernels, but among other exports are copra (from the coconut palm), guinea grains, gum copal, camwood, and beniseed. If once the natives inhabiting magnificent lands in this Colony were taught to cultivate economic plants in a systematic manner for purposes of export, the material wealth of the Gold Coast might be enormously increased.

Sierra Leone is a settlement with a coast line of about 180 miles, and an area of about 3,000 square miles. Agriculture is generally neglected, and the inhabitants are mainly supported by the trade which passes through the Colony from the interior. An effort has been made to establish a botanical station and model farm near Freetown in connexion with a botanical society, of which the Hon. S. Lewis is secretary. The finances of the Colony appear not to justify direct action being taken by the Government, but it is evident that, without official support, the aid of a skilled gardener, and regular supplies of seeds and plants, the results attained will not have an appreciable effect upon the welfare of the settlement.

The Gambia is a comparatively small settlement, the total area being about 69 square miles. The chief exports are ground-nuts, rice, maize, palm kernels, and india-rubber.

The Colony and Protectorate of Lagos contains an area of about 1,071 square miles, and an estimated population of 100,000. It was separated from the Gold Coast Government in 1886, and erected into a separate Colony with Captain Moloney as the first Governor.

Lagos has unrivalled water communication with the interior, and a very extensive trade has therefore grown up, amounting to nearly a million and a quarter sterling annually. The exports are palm oil and kernels, gum copal, cotton and guinea grains. This Colony, possessing excellent soil on the mainland, and good communication with the interior, offers every inducement to the extension of native cultures.

The first botanical station on the West Coast of Africa could not be better placed than at Lagos, nor entrusted to more sympathetic hands than those of Captain Moloney. On the occasion of the latter's visit to this country last year, he prepared a memorandum on the subject for the approval of the Secretary of State. This memorandum was based

* Sketch of the Forestry of West Africa, with Particular Reference to its Principal Commercial Products. By Alfred Moloney, C.M.G., of the Government of the Colony of Lagos. (London: Sampson Low, Marston, Searle and Rivington, 1887.)

on that already adopted for the West Indian Colonies, but modified to suit the special circumstances of West Africa.

MEMORANDUM prepared by CAPTAIN MOLONEY on establishing a
Botanic Station at Lagos.

The experiment as an Executive act may be left, in the first instance, to the Governor, or it may be deemed expedient to pass an Ordinance to make provision for the establishment at Lagos of a botanic station for the development as an industry of its economic botany.

Objects.

The growth of specimens of indigenous trees and plants of marketable value (or likely to prove so) that may serve on development as visible means of instruction to the natives of the Colony and of the interior kingdoms who visit the Government from time to time.

A practical agricultural school to be the means of diverting some of the young blood of the country in the direction of agricultural pursuits, and so lessen the general tendency of the rising educated youth to become 'merchants and clerks.'

An established centre for the introduction and subsequent development of alien elements of economic botany of commercial importance elsewhere.

A nursery for economic tropical plants of commercial importance.

Such an enterprise must anticipate what commercial benefit may in a few years be brought about by the steady distribution of young trees of economic value among the chiefs and people of the many villages that border the net-work of water which permeates the Colony and its neighbourhood.

Superintendent.

A superintendent at a salary, with quarters, of from 100*l.* to 150*l.*, annual increment of 10*l.* No perquisites.

He should be trained in the general details of nursery work, and be acquainted with the methods pursued in the treatment of seeds, and for propagating plants by cuttings and slips, potting them in local earthen pots, and generally preparing them for distribution.

Gardener and Labour.

He would require under him a gardener at 30*l.* per annum, two labourers at 1*s.* per diem each. Potting and tool shed would represent an initial cost of 20*l.* Cost of tools and incidental expenses may be put down at 12*l.* per annum.

Again, quarters will have to be provided; total cost of service may be estimated at 300*l.*

Site.

The main features to be secured are good soil, comparative freedom from atmosphere impregnated with salt, good supply of fresh water on the spot, protection by hill or belt of trees against tornadoes or other strong winds, and accessibility either by water or by good road; enclosure, palm fence at first, later, a brick wall, as bricks can be made on the spot. For shading purposes, banana, plantain, and palm leaves can be had on the spot.

Management.

In an executive sense, for the present, this establishment should be deemed to be a branch of the Public Works Department, and be annually voted for as such.

Honorary Committee.

To ensure progressive management and healthy supervision, there should be an honorary committee of such gentlemen as the governor may appoint by the year, over which he himself would preside. The chief points that require attention as regards the supervision of the station are the regulation of working hours, the prompt treatment of seeds and plants immediately they arrive, the assignment of plants ready for distribution, and the due supervision of the station, so as to keep it in an efficient working condition for supplying the special needs of the Colony. A small charge, sufficient to cover the cost, may be made for all plants raised at the station, while for imports direct, the cost must be classed as incidental, and be charged accordingly.

Gratuitous Distribution of Plants.

Whenever it may be advantageous to the general interest, a gratuitous distribution may proceed under the authority in writing of the Governor.

Cocoa Nut growth in hands of Government.

Towards a future export of copra and coir, the development of the cocoa nut palm proceeds in the Colony of Lagos in the hands of the Government, whose lead has to some extent being followed by the natives.

Direction of efforts of Superintendent.

In addition to the points mentioned under "objects" in favour of the establishment of such an institution as is proposed, the efforts of the superintendent should be directed to the—

- (a.) Promotion of extension of growth of the cocoa nut palm.
- (b.) Introduction of a better class of cotton and its extended growth.
- (c.) Culture of the naturalised tobacco, and improvement therein by importation of suitable seed.
- (d.) Growth of ginger, cacao, pepper (red), and coffee.
- (e.) Development of the rubber, gum, and resin tree, and of fibres.
- (f.) Growth and judicious planting of Eucalyptus, Melaleucas, and the Casuarinas.
- (g.) Model kitchen gardening.

I append a list, by the Assistant Director of Kew, of plants suitable for native culture in West Africa.*

Blind adherence to one industry only means commercial ruin, as was proved, to the cost of many, in some of our colonies. "Eggs-in-one-basket" policy has proved disastrous.

Publication of Proceedings.

To extend encouragement and to bring home a proper sense of responsibility, there should be rendered for publication in the Government Gazette quarterly, to the Colonial Secretary, a brief account of work done, embodying acknowledgment of receipts into, and issues from the station.

* Not published.

Apprenticeship of Refugee Boys.

Further, as to the establishment suggested, I would remark, that in addition to the staff proposed, refugee (ex-slave) boys might be apprenticed under Government for such agricultural training as the station will offer, and I hope that, after the conference I mean to have with the London Directors of the branch of the Hussey Charity established at Lagos, on the advisability of working their boys half-timers as regards the industrial work of the station, general benefit in such direction also may be derived.

Industrial Education of Sons of Chiefs.

I would venture also to urge upon the Government the desirability of utilizing such a centre for the regular education therein of three or four sons of important chiefs in or outside the Colony. Their maintenance would not cost much, say, 100*l.* a year, and could form an additional charge to vote "Aborigines." The result of such a policy would prove of great value to the country.

In drawing up this scheme, I have conferred personally with Mr. Morris, the Assistant Director of Kew Gardens, whose experience I have utilized in some measure, for which I must give him my acknowledgments. I am also again indebted to the Director.

In a scheme of this kind and extent, there must be many minor matters of detail that will present themselves later, and can, I think, be left with advantage in the hands of the Governor of the Colony.

At the request of the Secretary of State, the selection of a suitable man to take charge of the botanical station at Lagos was entrusted to Kew. The difficulty as regards the climate of West Africa and its unsuitability for laborious service on the part of a European gardener was solved by obtaining a creole gardener trained by the botanical department of Jamaica. Mr. James MacNair, the man appointed, had been in charge of the Hope Nurseries at Jamaica for seven years, and was highly recommended for his experience and knowledge of economic plants and the details of tropical agriculture. On his way from Jamaica to West Africa, he spent some time at Kew, and took out with him a Wardian case of plants and numerous packets of seeds with which to start operations at Lagos. In March of this year a further supply of seeds comprising 200 packages, obtained from the botanical gardens of Calcutta, Ceylon, and Jamaica, was forwarded from Kew to Lagos.

As indicating the nature of the duties in which Mr. MacNair is engaged at Lagos, the following extract from a letter received from him on the 12th January last, will be read with interest:—

"I beg to say that a great many of the seeds from Jamaica and Kew, which I brought over with me, are doing well. I have them potted up in bamboo pots. I shall be very glad to get a further supply of all kinds of fruit and timber trees of the West Indies, such as Mahogany, Cedar, Juniper, &c. I am glad to inform you that I have succeeded in getting a few seeds of the No. 11 Mango and Black Mango, which I took with me from Jamaica to grow, and I shall be able soon to propagate plants from them by grafts. I find that the Guinea Grass is very scarce; there are a few roots scattered about the country, but of a coarse kind, like the St. Mary's Grass of Jamaica, but not known in the country as a fodder for stock. Also the Guinea Corn is a very poor kind. I would like much to have some good seeds. The plants from Kew, which I have established in their permanent places, are

“ doing well. They look quite healthy, especially the Logwood, Annatto, Divi-Divi, *Theobroma Cacao*, &c. I am still staying in the town of Lagos, the station-house being not yet completed.”

Again, on the 6th March last, Mr. MacNair wrote as follows :—

“ I have been engaged during the last two months making a road from the entrance to the Superintendent’s house, seven feet in width, and planted out with a border of Bahama grass, three feet in width, and making up a couple of beds round the house for flowering and ornamental plants, which will give the place a neat appearance. The nursery is well sheltered with large fig trees, and in addition, I have put up a shed covered with palm leaves for protecting the younger plants. Our fence at present is a temporary one, made of palm leaves, but I expect soon to have a good fence put up. I have recommended a barbed-wire fence. My supply of water is not enough for irrigation purposes, and only just enough for watering plants. The river water cannot be used, as it is too salt, except in the rainy seasons, when it is fresh. The Governor has supplied me with a large quantity of Liberian coffee seeds, which have grown very nicely. I am now potting them, and expect to get over 15,000 plants, which the Governor intends to distribute amongst the principal native men of the country. I have planted out a few of all the different fruit trees which I have in stock, also a few Liberian coffee and cacao, about the place as an experiment. The plants from Kew are all in good condition, and doing well. The Logwood is fully two feet in height, and I am now taking cuttings from it. Our quarterly report is not ready for this mail, and will not be for a couple of weeks. . . . I have got a good supply of botanical books on hand; also the Kew Bulletin, sent me by the Governor, which I am making use of. The wish of the Government is to encourage the growth of indigenous trees and plants of marketable value, so that they may serve as a visible means of instruction to the natives of the country.”

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, May 5, 1888.

I AM directed by the Secretary of State for the Colonies to transmit to you, for your information, a copy of a despatch from Captain Moloney, transmitting the first report on the botanic station at Lagos.

I am, &c.,
The Director, (Signed) R. G. W. HERBERT.
Royal Gardens, Kew.

[Enclosure.]

GOVERNOR MOLONEY to COLONIAL OFFICE.

SIR, Government House, Lagos, March 19, 1888.

IN reference to your despatches, No. 45, of April 7, and No. 144, of October 3, 1887, I have the honour to forward the first report on the botanic station of this Colony, viz., for the quarter ended December 31, 1887.

2. The work done up to the present time augurs well for its future usefulness and importance as a teaching centre and dépôt whence may be spread information on the utility, value, and mode of culture of trees

and plants, and eventually a distribution of seeds and plants for cultivation among the natives effected.

4. The superintendent, Mr. J. MacNair, is a very good man for the post; a hard worker, with a sound, practical knowledge of his work, in which he takes a great interest. For his selection, as well as for supplies of specimen plants and seeds, the Colony is again much indebted to the Director and Assistant Director of the Royal Gardens, Kew, to whom I would ask you to be good enough to supply a copy of the report now transmitted.

I have, &c.

(Signed) ALFRED MOLONEY.

The Right Hon. Lord Knutsford.

REPORT on the BOTANIC STATION, LAGOS, for the Quarter ended
31st December 1887.

At the end of the first quarter of 1887, the Right Honourable the Secretary of State for the Colonies was pleased to approve of a scheme for the establishment, as a branch of the Government at Lagos, of a botanic station. The details of the scheme have been communicated to the local press, and appeared in the "Lagos Observer" of the 21st to 28th January 1888. To make a start and to have a suitable place for a nursery by the arrival of the superintendent, the house and compound at Ebute Metta of Bishop Crowther, admirably suited for the purpose, were put in order, and rented temporarily by the Government during September quarter. Mr. MacNair, who was selected in Jamaica for the post of superintendent, arrived with his family in the Colony on the 8th November 1887, and occupied his present quarters at Ebute Metta on the 19th January 1888.

Ebute Metta, on the mainland, was decided on as the most suitable site for such an establishment. The site there chosen offered the main features to be secured, viz., good drainage, being a slope down to the edge of the water-way, by which it is approached from Lagos in a quarter of an hour by steam launch, and half an hour by boat; a comparatively good soil; freedom from an atmosphere impregnated with salt, being over three miles from the sea; protected by a handsome belt of trees (figs) against tornadoes, which generally blow from N.W.; and accessibility by water. A public ferry plies also between Lagos and Ebute Metta, and is much and daily used.

The area of the land enclosed is $3\frac{3}{4}$ acres, which has been cleared and temporarily fenced in with bamboo and palm leaf fencing, at a cost of 11*l.* 15*s.* The work of grubbing, weeding, levelling, path-making, proceeds; steel-barbed wire-fencing has been ordered from England. This fence, when erected, is intended to have a height of 5 feet in eight strands, the four lower being placed close together to prevent sheep, &c., from entering the garden, and supported by mangrove posts, which resist the ravages of the white ant.

As regards accommodation, there were two houses with out-buildings on the site, one of which has been repaired at a cost of 124*l.* 12*s.* 3*d.*, including out-buildings. This now represents the residence of the superintendent. The out-buildings include potting and tool-room; but the shelter of the avenue of figs, referred to in a previous paragraph, presents a capital open-air potting room and nursery, and one which is preferred. The second house is now undergoing repair at an estimated cost of 76*l.*; it will contain the superintendent's office, remaining

accommodation being intended for gardeners and apprentices. Both houses were in a dilapidated condition, the latter particularly so.

Two wells have been dug at a cost of 6*l.* 5*s.*, about 23 feet deep each, and give a depth of good water of about 2 feet 6 inches. In time they are to have pumps and water-butts fixed alongside.

The present *employés* under the superintendent are represented by two sub-gardeners and two labourers.

It is intended in time to take in a limited number of day scholars to learn practical gardening, when it is to be hoped educational bodies and parents will take advantage of the arrangement.

A small botanical library has been supplied for the use of the superintendent and apprentices.

In the quarter ending 30th June 1888, plants will be available for distribution by sale at a very low rate, and otherwise; a list will be from time to time published.